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(NASA-CR-161097) KING 2 2519 ATM RESIDUAL
GYROS: REESTABLISHING 5 YEAR LIFE
REQUIREMENTS (Singer-Kearfott, Little Falls,
N. J.) 35 p HC A03/MF A01 CSCI 14B

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KING II 2519 ATM
RESIDUAL GYROS
REESTABLISHING 5 YEAR LIFE REQUIREMENTS
CONTRACT NO. NA8-32837

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1. DESCRIPTION

The purpose of this program is to provide the necessary technical expertise to assess the condition of the residual ATM 2519 Singer, Kearfott Gyros. This effort includes a summary of past build history records, a summary of past performance characteristics, recommendations for particular tests (which were performed by NASA personnel), and review and analysis of the test results. In addition, a study of motor performance data and recommendations concerning gyro spin bearing life was performed. Method of reestablishing potential reliability of the bearing for the 5 year life requirement of the Power Module is also included.

2. DISCUSSION

On May 16, 1978 a meeting was held between the representatives of NASA and Singer/Kearfott Division. In attendance were G. Fikes, T. Morgan, R. McIntosh of NASA and B. Kayal, L. Carbocci of Kearfott. The purpose of this meeting was to discuss what tests could be performed on the fourteen (14) residual ATM 2519 gyros which would lead NASA to a level of confidence that could permit the use of these units in a new satellite to be launched with a five (5) year proposed life.

The fourteen gyros were retrofited on the Kearfott facility to the -4 configuration in 1974, while their Motor/Floats, built in 1967, were used as is. The fourteen subject gyros, at the Space Center, were on the shelf for four (4) years and are at two (2) different levels of assembly. Ten (10) are in single axis platforms, while the remaining four (4) gyros are on the shelf, held in abeyance ready to be used in case the need arises for a gyro replacement. As a result of this meeting a test plan was subsequently drafted by S-KD, submitted, and approved by NASA.

2. DISCUSSION (cont'd)

NASA sample selected six gyros from single axis packages and four "loose" gyros for motor data and subjected them to the following test plan:

1. 100 hour burn-in.
2. Room temperature resistance check.
3. Drift runs on the six gyros in the platforms.

Collected data:

- a. MUSA
 - b. MUIA
 - c. R (OAV)
 - d. Random drift (IAV) 2 hours.
4. Motor characteristics on the four loose gyros.

Characteristics checked were;

- a. 0-400
- b. 400-0
- c. 400-390
- d. 390-400
- e. 30-20
- f. Ps
- g. Pr
- h. Is
- i. Ir

The data to be taken and evaluated was at;

100th hour
125th hour
150th hour
175th hour
200th hour

2. DISCUSSION (cont'd)

A review of the drift and motor data presented has been completed. The data taken by NASA is presented in Appendix I. This includes package drift data Figures I thru VII. Gyro motor data is provided in Appendix II, Figure VIII thru Figure XI. The summary and analysis of this data is presented in Appendix II Figure XII. The serial numbers of the packages and gyros tested is presented in Appendix III. Day-to-Day run-up repeatability and max. spread between SKD and NASA data is presented in Appendix IV.

The as shipped MUSA data run-up to run-up repeatability was $< .090^{\circ}/\text{Hr}/\text{G}$ for the six units tested. Their average value was .062. For these same units, the NASA data run-up to run-up repeatability was $< .054^{\circ}/\text{Hr}/\text{G}$ and their average was .038 indicating the units were still stable.

Similarly, the as shipped MUIA data run-up to run-up repeatability was $< .117^{\circ}/\text{Hr}/\text{G}$ and their average reading was .056 and the NASA data run-up to run-up repeatability was $< .210^{\circ}/\text{Hr}/\text{G}$ and the average reading was .092. Although the readings on the IA are higher than those recorded on the SA, S-KD considers the gyros to be stable.

The as shipped Restraint (Roav) data was $< .063^{\circ}/\text{hr. max.}$ and the average was .027 for the six sample units tested. The NASA Roav readings were $.021^{\circ}/\text{hr. max.}$ and the average was .014. All the data accumulated indicated that the units are not erratic and that the units are stable within the gyro specifications.

2. DISCUSSION (cont'd)

Comparing the as shipped MUSA data with the data obtained at NASA, the max. spread observed was on Serial #110 ($.276^{\circ}/\text{Hr}/\text{G}$). Similarly, the max. spread observed on the IA was on Serial #110 which was $.562^{\circ}/\text{Hr}/\text{G}$. The max. spread observed for restraints was on Serial #114 which was $.263^{\circ}/\text{Hr}$.

After analyzing the recent gyro data and considering the four (4) year shelf life the gyros experienced, S-KD feels that these gyros are still in operating condition.

A review of the initial NASA motor data supplied in June and July of 1978 revealed some discrepancies. All motor data changed in the same direction when comparing as shipped S-KD data with recent NASA data. In general, the sync time (0-400 RUT) was longer, the high end (400/390 RDT, 390/400 RUT) data indicated losses were high and as a result the corresponding reserve torque decreased. The total and low end rundown time (400/0 RDT, 30-20 RDT) increased indicating lower preload and/or lower bearing friction. The starting and running power/currents were lower which indicated improper excitation voltage. NASA's data input of 7/25/78 indicated an out of balance excitation voltage of 3.5 voltage between phases. This may have accounted for the poor high end, sync time and power performances.

2. DISCUSSION (cont'd)

At this point in time, S-KD then asked NASA to repeat the motor runs with a regulated applied excitation voltage between phases accurate within 2%. The data presented in October 1978 utilizing the regulated supply was quite different. The high end data, the starting current and running current, and the sync time were comparable to that taken at S-KD. The only change noted was that the total rundown time and the 30-20 RDT data indicated some change in the motor/float and spin motor bearing system. However, at this point, the change does not appear to be significant enough to adversely affect motor life and gyro performance.

3. CONCLUSIONS

A review of the results indicate the gyro to be stable and the motor characteristics to be repeatable. It is Kearfott's opinion that the gyros are still in operating condition.

This conclusion is made with reservation contingent upon the findings as detailed in Section 4, Recommendations.

4. RECOMMENDATIONS

To assure that the gyro spin motor life expectancy can be extended for another 5 years, we recommend that the following program be conducted at the Singer/Kearfott facilities. All tests to be performed with the participation of a NASA Representative plus the Singer, Kearfott Engineering and Quality Representatives. Selection of the unit(s) to be evaluated will be by mutual agreement of the parties.

4. RECOMMENDATIONS (cont'd)

The tests/operations to be performed on the evaluation unit(s) should be the following:

- a. Gyro teardown.
- b. Functional and leak check at motor/float level.
- c. Run gyro motor/float an additional 50 hrs. at Kearfott facility.
- d. Accumulate data at the initial start of the run, after 1 hr., 25 hrs., and 50 hrs.
- e. Compare the results with the previous data.
- f. Teardown motor/float to the bearing level.
- g. Kearfott Engineering and Quality to make a determination of the bearing and lubrication system via 40X visual techniques.
- h. M&P Lab to evaluate and analyze the lubrication system.

APPENDIX I

RGP S.N. # 107

DATE	HRS	R _{SAV}	R _{IAV}	R _{OAV}	MU _{IA}	MUS _{RA}	PIS.D	P.3.SD	SF
8/23/78	1	.126784		.074058	.322895	—			450.73
8/24/78	8		.08484			-.007308			
8/25/78	17	.137335		.081604	.304027				450.89
9/14/78	30		.103464			-.057196			
9/28/78	200	.052535			.384117				
10/2/78	211			.093762			.00475		450.79
10/3/78	218		.096264			-.034359		.003512	
10/4/78	219	.018005			.394052				
10/4/78	223	.014492							

FIG. I

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RGP S.N. # 110

DATE	HRS	R _{SAV}	R _{IAV}	R _{OAV}	MU _{IA}	MU _{SRA}	PIS.D.	P.3.SD	SF
11/7/78	.5			.021522			.008038		451.35
11/8/78	6		.037473			-.138785		.005164	
	10	-.072827			.555633				
11/9/78	12			.033590			.003191		451.60
11/13/78	16			.042773			.002765		451.39
11/14/78	20		.046044			-.101699		.010168	
	25	-.001676			.383654				

FIG. II

RGP S.N. # 116

DATE	HRS	R _{SAV}	R _{IAV}	R _{OAV}	MUIA	MUSRA	PIS.D.	P.3.SD	SF
12/8/78	16			-.013334			.002008		451.39
	19		-.037515			.124767		.002993	
	23	-.064728			.211705				
12/11/78	28			.000884			.003879		451.51
	32		-.015359			.126338		.003041	
	37	-.097689			.203428				

FIG III

RGP S.N. # 118

DATE	HRS	R _{SAV}	R _{IAV}	R _{OAV}	MUIA	MUSRA	PIS.D	P.3.SD	SF
12/1/78	14			.068084			.003045		448.88
	18		-.014596			-.107909		.002835	
	23	-.026339			.615573				
12/4/78	26	.060294			.572073				
12/5/78	42			.062512			.002635		448.74
	46		.012422			-.056090		.004006	
	50	.011332			.580675				

FIG IV

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RGP S.N. # 120

DATE	HRS	R _{SAV}	R _{IAV}	R _{OAV}	MUIA	MUSRA	PIS.D	P.3.SD	SF
12/12/78	11			.063786			.006526		450.60
	17		.046645			-.120068		.009661	
	21	.046415			.194013				
12/13/78	37			.079532			.006851		450.70
	41		.057774			-.223325		.010843	
	45	.072545			.175127				

FIG. V

RGP S.N. [#]124

DATE	HRS	R _{SAV}	R _{IAV}	R _{OAV}	MUIA	MUSRA	P!S.D.	P.3.SD	SF
11/21/78	20			.055581			.003167		450.15
	23		.071338			-.154051		.005529	
	27	-.063995			.383841				
11/22/78	45			.033497			.003555		450.69
	48		.028933			-.100016		.009240	
	52	-.090418			.362433				

FIG. VI

RGP S.N. # 114

DATE	HRS	R _{SAV}	R _{IAV}	R _{OAV}	MUIA	MUSRA	PIS.D.	P.3.SD	SF
9/19/78	1			.013112					450.47
9/22/78				.017808			.00846		450.52
9/25/78				.022191					450.65
9/26/78			.015427			.045856		.008247	
9/27/78	50	-.186098			.33804				
10/16/78	208			.023342			.005866		450.55
10/17/78	214	-.062365			.373778				
10/18/78	217		-.001109			.012845		.012845	
10/19/78	225	-.252959			.544890				
10/20/78	231	.116761			.335043				
10/20/78	235	.137367			.326342				

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FIG. VII

APPENDIX I REVIEW

QVCO Data D.M.H

ST ⁰	NUVA 1/4/1/4		NUVA 1/4/1/4		RAN 1/4/1/4		RAN 1/4/1/4		RAN 1/4/1/4	
	ATD 540	NASA	ATD 540	NASA	ATD 540	NASA		NASA		NASA
107	.152	-.007	.172	.323	-.077	.074		.025		.127
023	.185	-.057	.172	.304	-.014	.082		.103		.137
	.164	-.034	.176	.383	-.034	.074		.076		.053
Sync Time	.188		.178	.393	-.015					.018
-	.154		.184	.367	-.021					.314
110	.164	-.139	.058	.556	-.138	.022		.037		.073
027	.174	-.102	.111	.385	-.132	.036		.046		.002
	.174		.018		-.135	.013				
Sync Time	.105		.019		-.140					
63 Sec	.143		.006		.142					
114	-.123	.015	.082	.333	-.240	.013		.015		-.186
005	-.179	.013	.084	.374	-.239	.017		-.001		-.062
	-.151		.088	.545	-.228	.022				-.252
Sync Time	-.155		.091	.335	-.233	.023				.116
-	-.213		.092	.326	-.207					.137
116	-.083	.123	-.080	.212	.024	-.013		-.038		-.004
017	-.057	.126	-.053	.203	.019	.001		-.015		-.098
	-.050		-.046		.028					
Sync Time	-.084		-.031		.020					
67 Sec	-.066		-.059		.017					
118	-.162	-.108	.107	.616	.115	.068		.016		-.026
016	-.229	-.056	.182	.572	.103	.062		.012		.060
	-.197		.169	.580	.130					.011
Sync Time	-.200		.117		.104					
75 Sec	-.186		.104		.090					
120		-.170		.194		.063		.047		.046
014		-.223		.175		.080		.053		.073
Sync Time										
70 Sec										
124	-.059	-.154	-.076	.384	.220	.056		.071		-.064
108	.008	-.100	-.031	.312	-.217	.038		.079		-.070
	-.074		-.034		-.220					
Sync Time	.000		.017		-.218					
71 Sec	.077		.063		.213					

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APPENDIX II

UNIT NO: 006 MOTOR NO: 717 FLOAT NO. 516

1978

DATE	6/2	6/5	6/6	6/7	6/8	6/9	6/12	6/13	6/14	6/15	10/10	10/10
TIME	15:50	9:14 15:21	8:54 9:00	14:11	14:44	15:06	13:20	13:15	12:47	13:06		
START POWER 7.5 V.A. AΦ	4.08	4.12	4.54	4.54	4.52	4.29	4.48	4.65	4.63	4.18		
START CURRENT												
300MA w/ max AΦ	170	171	188	186	188	191	186	193	192	187	207	206
RUNNING POWER												
5.5 V.A. AΦ	3.52	3.56	4.18	4.09	4.09	3.99	4.05	4.05	4.08	4.07		
RUNNING CURRENT												
250MA MAX AΦ	191	191	173	170	169	165	167	167	169	168	191	190
SYNC TIME	-	54	55	54.4	55	54.4	54.9	54.6	54.5	56	57.5	57.2
R.D.T. 400/390 C.P.S.	3	3.3	-	3.5	3.4	3.0	3.3	3.2	3.2	3.1	5.0	4.9
R.J.T. 390/400 C.P.S.	4	3.7	-	3.8	3.8	3.7	3.8	3.6	3.8	3.8	3.2	3.2
R.D.T. 400/0 C.P.S.	561	-	-	846	820	856	840	869	878	867	648	661
R.D.T. 30/20 C.P.S.	30	-	-	61.0	59.7	59.5	59.9	61.5	66.5	65.2	36.5	41.7
Cum. HPS	.16	6.28	6.38	13.05	35.55	60.38	131.04	154.94	178.44	202.77	203	204
LENGTH OF RUN HPS	.16	6.12	.1	6.67	22.5	24.83	70.66	23.9	73.5	24.3	1	1
(A-B) START											25.66	25.66
(B-C)											25.73	25.73
(A-C)											25.63	25.63
(A-B) RUN											25.91	25.99
(B-C)											25.94	25.99
(A-C)											25.96	25.90

FIG VIII

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UNIT NO: 023 MOTOR NO: 756 FLOAT NO. BSZ

1978

DATE	6/16	6/16	6/19	6/20	6/21	6/22	6/23	6/26		10/12	10/12	
TIME	9:52	12:03	10:32	10:09	12:21	13:28	8:53	13:10				
START POWER												
7.5V.A. AΦ	4.36	4.49	4.41	4.42	4.41	4.47	4.42	4.45				
START CURRENT												
300MA w/max AΦ	182	186	183	184	183	186	184	185		203	200	
RUNNING POWER												
5.5VA AΦ	3.98	3.98	3.97	3.98	3.98	3.98	3.96	3.98				
RUNNING CURRENT												
250MA MAX AΦ	165	165	164	165	165	165	164	165		190	189	
SYNC TIME	73.3	60.7	61.2	61	60.7	62	61.5	60.5		59.5	60.3	
R.D.T. 400/390 C.P.S.	-	3.3	3.2	3.3	3.4	3.4	3.4	2.9		4.8	4.6	
R.J.T. 390/400 C.P.S.	-	4.2	4.1	4.2	4.2	4.2	4.1	4.5		3.6	3.7	
R.D.T. 400/0 C.P.S.	-	565	615.5	639	660	587.5	619.5	657.4		457	486	
R.D.T. 30/20 C.P.S.	-	31.3	50.3	50.3	52.4	46.5	51.8	54.9		14.8	14.4	
Cum. HRS	-	2	72	95.4	121.6	146.75	166.09	238.49		238.9	239.6	
LENGTH OF RUN HRS	0	2	70	23.4	26.2	25.15	19.34	72.4		.5	.75	
(A-B) START										25.8	25.7	
(B-C)										25.7	25.6	
(A-C)										25.7	25.6	
(A-B) RUN										26.02	25.96	
(B-C)										25.98	25.91	
(A-C)										25.96	25.91	

FIG. IX

UNIT NO: 104 MOTOR NO: 761 FLOAT NO: 812

1978

DATE	6/27	6/27	6/28	6/29	6/30	7/3	7/5	7/6	7/7	7/10	10/10	10/10
TIME	12:08	14:46	14:46	13:29	12:00	9:37	9:34	8:17	8:39	8:25		
START POWER												
7.5VA AΦ	4.54	4.60	4.58	4.61	4.59	4.59	4.58	4.63	4.61	4.61		
START CURRENT												
300MA w/ MAX AΦ	189	191	190	192	191	190	190	192	191	191	207	206
RUNNING POWER												
5.5VA AΦ	4.23	4.21	4.22	4.22	4.24	4.24	4.27	4.26	4.24	4.21		
RUNNING CURRENT												
250MA MAX AΦ	175	174	174	175	175	175	176	176	175	174	199	198
SYNC TIME	65.7	62.3	61.9	62.5	62.5	62.2	62.2	62.0	62.5	62.3	61	60.8
R.D.T. 400/390 C.P.S.	-	3.1	3.2	3.0	2.9	3.3	3.0	3.0	3.1	3.0	4.5	4.4
R.U.T. 390/400 C.P.S.	-	4.1	4.2	4.4	4.2	4.1	4.1	4.1	4.2	4.3	3.9	3.9
R.D.T. 400/0 C.P.S.	-	540	600	597	569.8	602	579.5	569.2	635.4	620.6	466	463
R.D.T. 30/20 C.P.S.	-	30	34.2	37.1	41	37.9	41.0	48.5	45.2	48.6	18	18.5
Cum. HRS	-	2.63	26.63	49.33	71.83	141.43	189.38	212.09	236.4	308.15	308.6	309.1
LENGTH OF RUN HRS	-	2.03	24	227	22.5	69.6	47.95	22.75	24.30	71.75	.5	.5
(A-B) START											25.5	25.5
(B-C)											25.6	25.6
(A-C)											25.6	25.6
(A-B) RUN											25.97	25.97
(B-C)											25.96	25.96
(A-C)											26.0	26.0

FIG X

UNIT NO. 121 MOTOR NO. 779 FLOAT NO. 871

1978

DATE	6/28	6/29	6/30	7/3	7/5	7/6	7/7	7/10	10/11	10/12
TIME	14:07	10:07	12:39	9:02	10:00	8:58	9:29	-		
START POWER										
7.5 V.A. AΦ	4.70	4.74	4.77	4.76	4.76	4.80	4.80	4.80		
START CURRENT										
300MA w/MAX AΦ	179	182	183	183	182	184	184	184	208	209
RUNNING POWER										
5.5 V.A. AΦ	4.14	4.10	4.11	4.11	4.11	4.12	4.12	4.11		
RUNNING CURRENT										
250MA MAX AΦ	157	156	156	156	156	156	156	156	195	196
SYNC TIME	68	61.3	61.8	61.8	61.5	61.4	61.6	62.3	57.1	56.5
R.D.T. 400/390 C.P.S.	-	3.4	3.2	3.2	3.2	3.2	3.2	3.4	5.0	5.3
R.J.T. 390/400 C.P.S.	-	4.5	4.3	4.7	4.5	4.4	4.6	4.5	3.4	3.4
R.D.T. 400/0 C.P.S.	-	800	8776	876	829	861.2	896.5	892.3	585	602
R.D.T. 30/20 C.P.S.	-	63	61.5	63.5	58.6	70.0	67.3	67.6	77.8	29.4
Cum. HRS	-	3.3	12.62	81.02	129.99	152.89	177.47	232.97	233.3	234
LENGTH OF RUN HRS	-	3.3	9.32	68.4	48.97	22.9	24.58	55.5	.3	.75
(A-B) START									25.75	25.76
(B-C)									25.6	25.6
(A-C)									25.7	25.72
(A-B) RUN									26.03	26.08
(B-C)									26.01	26.06
(A-C)									26.00	26.04

FIG II

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APPENDIX II REVIEW

NASA KING II 2519 MOTOR DATA

	SN # 6			SN # 23			SN # 104			SN # 121	
	SKD	NASA		SKD	NASA		SKD	NASA		SKD	NASA
START CUR.	205	206		230	200		205	206		205	209
RUN CUR.	175	170		270	189		200	178		195	196
SYNC	54.2	55.2		59.8	60.3		59.5	60.8		55	56.5
400/3900	4.8	4.9		5.2	4.6		4.4	4.4		4.9	5.3
390/400	3.2	3.2		3.8	3.7		3.8	3.9		3.3	3.4
400/0	543.7	661		532.1	486		521.2	463		620.2	602
30/20	30.2	41.7		19.6	16.4		26	18.5		36.2	29.4

FIG 81

APPENDIX III

KING II 2519 ATM

NASA UNITS

4 GYROS

10 SINGLE AXIS PLATFORMS

PLATFORM SN#	GYRO SN# C702519018-4	MTR/FLOAT SN# B200041307-1	MOTOR SN# C704704020
124	121	871	779
	006	816	717
	108	818	710
	105	863	765
	011	824	732
118	016	834	706
116	017	823	738
107	023	856	756
114	005	820	726
110	101	857	750
	027	826	772
	118	858	771
	104	812	761
	014	—	—

APPENDIX IV

GYRO DRIFT DATA

RUN TO RUN REPEATABILITY

Δ BETWEEN RUNS

RUN TO RUN REPEATABILITY

SN#	Δ MUSA		Δ MUIA		Δ ROAY		Sync Time	
	SKD	NASA	SKD	NASA	SKD	NASA	SKD	NASA
107	.036	.050	.026	.089	*.063	.020		
110	.069	.037	*.117	.171	.101	*.021	60	63
114	*.090	.032	.010	*.219	.036	.010		
116	.033	.003	.049	.009	.007	.014	60	67
118	.067	.052	.078	.044	.040	.006	54	75
124	.081	*.054	.059	.022	.007	.018	57	71
Ave	.062	.038	.056	.092	.027	.014		

MAX Δ BETWEEN SKD & NASA

SN#	MAX Δ MUSA	MAX Δ MUIA	MAX Δ ROAY
	SKD / NASA	SKD / NASA	SKD / NASA
107	.245	.221	.171
110	.276	.562	.185
114	.258	.463	.263
116	.210	.292	.041
118	.173	.512	.068
124	.176	.460	.276

NOTE: * IMPLIES MAX. READINGS

APPENDIX V

MISCELLANEOUS DATA

SKD MOTOR DATA

SKD GYRO DRIFT DATA

NASA GYRO MOTOR ACCUMULATIVE HRS.

1st mtr/Flight Run	51	52	53	54	55	56	57	58	59	60
Distance 242	212	271	23	206	207	206	216	224		
Starting Gear	w 6.4	6.4	6.3	6.3	6.6	5.5	6.6	6.3		
Starting Current	mA 205	206	205	209	230	200	180	205	206	200
Running Power	w 4.1	3.9	3.9	3.9	3.9	4.0	3.35	3.9	4.1	
Running Current	mA 200	198	195	196	215	170	189	190	195	190
PDT 400-390	sec 4.4	4.4	4.4	5.3	4.4	5.2	4.6	4.8	4.3	4.8
CUT 390-400	sec 3.8	3.9	3.3	3.4	3.7	3.8	3.7	3.3	4.2	3.2
PDT 30-20	sec 26	18.5	36.2	29.4	150	17.1	16.4	31.2	20.4	30.2
PDT 400-0	sec 521.2	463	620.2	602	424.3	512.1	486	621.8	413.9	543.7
CUT 0-400	sec 57.5	46.9	55	56.5	59.5	57.8	60.3	53.6	62.7	54.2
	52	104	121	105	023	101	27	006	011	

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PIN 5203519018-Y		OHMS		OHMS		M.V		TORQUE SCALE FACTOR * IN MM.		OHMS		MA. M.A. SEC.		TORQUE SCALE FACTOR & DRIFT RATES					
SIN	PINS	FINAL TEST	PRE SHIP	CONTROL 10000A 0.050 TEMP	MONITOR 10000A 0.050 TEMP	NULL FUND	VOLUME TOTAL	GYRO GAIN	ANGULAR FREEDOM IN PHASE OUT OF PHASE	TORQUE RES. OP. TEMP.	MV/DEG. SCALE FACTOR	MOTOR ST. I RUN I SYNC	1ST RUN	2ND RUN	3RD RUN	4TH RUN	5TH RUN		
016	A-B	39.79	40.02	744.8	745.8	0.25	0.80	11.75	2.04	2.07	169.0	417.5	203 196 5425	T.S.F	0.0397	0.0397	0.0397	0.0397	0.0397
SN 118	B-C	40.12	40.39											MUSA	0.162	0.129	0.197	0.200	0.126
	C-A	40.10	40.36											MUSA	0.107	0.182	0.169	0.117	0.124
	P-M	14.35	14.56											ROAV	0.115	0.103	0.120	0.104	0.090
	W-U	256.3	255.7											RANDOM DRIFT					
	T-R	144.7	145.5											TWO	10	1AV	0.004	0.004	0.004
	H-K	621.5	625.9											DAY	10	0AV	0.002	0.002	0.002
	D-E	30.35	30.36											DAY	10	1AV	0.024	0.024	0.024
	L-J	626.2	627.6											DAY	10	0AV	0.005	0.005	0.005
017	A-B	40.58	42.05	750.0	754.0	0.65	0.90	10.42	1.861	2.150	170.0	468.0	185 170 60.4	T.S.F	42.0	41.9	42.0	42.0	42.0
SN 116	B-C	40.96	42.57											MUSA	0.093	0.057	0.050	0.074	0.066
	C-A	39.92	41.38											MUSA	0.093	0.053	0.086	0.031	0.059
	P-M	14.72	15.13											ROAV	0.024	0.019	0.023	0.020	0.027
	W-U	266.4	274.7											RANDOM DRIFT					
	T-R	146.5	150.7											TWO	10	1AV	0.007	0.007	0.007
	H-K	629.7	652.0											DAY	10	0AV	0.007	0.007	0.007
	D-E	30.84	30.87											DAY	10	1AV	0.024	0.024	0.024
	L-J	626.3	648.0											DAY	10	0AV	0.007	0.007	0.007
011	A-B	40.34	40.66	735.0	741.0	0.66	0.68	11.23	2.08	1.95	172.2	463.0	204 193 57.62	T.S.F	40.6	40.6	40.5	40.5	40.6
	B-C	41.22	41.50											MUSA	0.127	0.234	0.043	0.057	0.077
	C-A	40.82	41.13											MUSA	0.126	0.171	0.171	0.162	0.224
	P-M	14.21	14.33											ROAV	0.184	0.185	0.167	0.164	0.181
	W-U	271.2	273.1											RANDOM DRIFT					
	T-R	147.9	149.0											TWO	10	0.22	0.007	0.007	0.007
	H-K	625.5	631.0											DAY	10	0.007	0.007	0.007	0.007
	D-E	31.05	31.09											DAY	10	0.102	0.102	0.102	0.102
	L-J	620.5	626.9											DAY	10	0.007	0.007	0.007	0.007

TORQUER SCALE FACTOR * IN MU.

PIN C702519018-Y		OHMS		OHMS		M.V.		DFC		OHMS		MU/DEG		MIA MA SEC		TORQUER SCALE FACTOR & DRIFT RATES							
S/N	PINS	FINAL TEST	PAG SNA	CONTROL TEMP	MONITOR SENSITIVITY	FLAND NULL	TOTAL NULL	GYRO GAIN	ANGULAR FREQUENCY IN DEG/SEC	ANGULAR FREQUENCY IN DEG/SEC	TORQUER SENSITIVITY	SCALE FACTOR	SCALE FACTOR	SCALE FACTOR	SCALE FACTOR	1ST RUN	2ND RUN	3RD RUN	4TH RUN	5TH RUN	DRIFT RATE		
104	A-B	40.64	40.92			750.0	750.0	0.46 0.57	11.25	1.968	1.775	162.9	468.0	191	187	5740	T.S.F	40.8	40.8	40.8	40.8	40.8	0.001/mu
	B-C	41.50	41.72													MUSA	0.267	0.247	0.253	0.249	0.264	0.001/mu	
	C-A	40.82	41.07													MUSA	0.219	0.239	0.226	0.231	0.259	0.001/mu	
	P-M	14.52	14.63													RAV	0.280	0.260	0.241	0.253	0.265	0.001/mu	
	W-U	258.0	256.7													RANDOM DRIFT							
	T-R	140.8	141.7													TWO	10	1AV	0.012				
	H-K	633.8	638.6													DAY	10	0AV	0.002				
	D-E	30.60	30.57													DAY	10	1AV	0.002				
	L-J	633.0	638.2													DAY	10	0AV	0.001				
027	A-B	43.53	41.80			734.0	747.0	0.57 0.58	12.01	2.06	1.97	168.2	447.5	167	151	6442	T.S.F	40.8	40.8	40.8	40.8	40.8	0.001/mu
SN 110	B-C	44.77	43.17													MUSA	0.164	0.174	0.174	0.185	0.143	0.001/mu	
	C-A	43.66	42.08													MUSA	0.057	0.111	0.018	0.019	0.006	0.001/mu	
	P-M	15.08	14.51													RAV	0.138	0.132	0.135	0.140	0.142	0.001/mu	
	W-U	273.3	263.0													RANDOM DRIFT							
	T-R	150.2	144.6													TWO	10	1AV	0.008				
	H-K	652.3	625.2													DAY	10	0AV	0.002				
	D-E	30.62	30.58													DAY	10	1AV	0.029				
	L-J	641.0	614.4													DAY	10	0AV	0.004				
101	A-B	40.61	41.39			746.0	752.0	0.70 0.80	11.46	2.044	1.967	172.1	450.0	195	179	5538	T.S.F	0.0713	0.0713	0.0713	0.0713	0.0713	0.001/mu
	B-C	41.53	42.31													MUSA	0.149	0.172	0.170	0.177	0.207	0.001/mu	
	C-A	40.88	41.65													MUSA	0.081	0.062	0.073	0.073	0.052	0.001/mu	
	P-M	14.13	15.06													RAV	0.342	0.317	0.300	0.325	0.305	0.001/mu	
	W-U	261.7	266.6													RANDOM DRIFT							
	T-R	147.7	150.6													TWO	10	1AV	0.007				
	H-K	630.0	642.6													DAY	10	0AV	0.008				
	D-E	31.72	31.74													DAY	10	1AV	0.024				
	L-J	624.6	637.4													DAY	10	0AV	0.003				

TORQUEIR SCALE FACTOR π IN μ .

PIN C702519019-Y		OHMS		OHMS		M.V.		DEC.		OHMS		MV/DEC.		M.A. M.A. SEC.		TORQUEIR SCALE FACTOR & DRIFT RATES						
S/N	P.N.S	FINAL TEST	PRE SHIP	CONTROL SECTION OPER. TEMP	MONITOR SECTION OPER. TEMP	NULL FUND	UNITED TOTAL	CYNO GAIN	ANGULAR IN PHASE	FREEDOM OUT OF PHASE	TORQUEIR OPEN TEMP	SCALE FACTOR	ST I	MOTOR RUN I	WIND SYNC	1ST RUN	2ND RUN	3RD RUN	4TH RUN	5TH RUN		
005	A-B	39.42	39.50	747.0	748.3	0.38	1.10	10.86	1.89	1.81	169.3	465.0	194	186	5753	T.S.F	40.2	40.2	40.2	40.2	40.2	0.001/m
SN 114	B-C	39.87	39.97													MUSE	0.123	0.129	0.151	0.155	0.213	0.001/m
	C-A	39.94	40.03													MUSE	0.082	0.084	0.088	0.091	0.092	0.001/m
	P-M	14.47	14.48													ROLV	0.210	0.239	0.228	0.238	0.207	0.001/m
	W-U	264.3	265.8													RANDOM DRIFT						
	T-R	145.4	146.2													TWO	15	1AV	0.014			
	H-K	626.3	630.8													DAY	15	0AV	0.004			
	D-E	30.55	30.51													DAY	15	1AV	0.034			
	L-J	635.0	628.9													DAY	15	0AV	0.005			
023	A-B	42.72	43.84	751.9	757.5	0.84	0.94	10.23	2.11	1.86	168.6	472.5	177	168	60.15	T.S.F	0.077	0.077	0.077	0.077	0.077	0.001/m
SN 107	B-C	42.64	43.73													MUSE	0.152	0.185	0.164	0.171	0.154	0.001/m
	C-A	42.60	43.73													MUSE	0.172	0.172	0.176	0.171	0.184	0.001/m
	P-M	14.26	15.18													ROLV	0.021	0.044	0.034	0.045	0.021	0.001/m
	W-U	216.3	223.20													RANDOM DRIFTS						
	T-R	145.2	149.10													TWO	15	1AV	0.001			
	H-K	635.5	653.3													DAY	15	0AV	0.001			
	D-E	30.01	30.04													DAY	15	1AV	0.017			
	L-J	631.1	648.7													DAY	15	0AV	0.003			

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PIN C722519018-4		OHMS		OHMS		M.V.		DEG.		OHMS		MV/DEG.		M.A. M.A. SEC.		TORQUE SCALE FACTOR		DRIFT RATES	
S/N	PINS	FILE P2E TEST SHIP	CONTROL SENSOR A OPER. TEMP	CONTROL SENSOR B OPER. TEMP	NULL VOLTAGE FUND. TOTAL	GYRO GAIN	ANGLAR IN PHASE	ANGLAR OUT OF PHASE	TORQUE SENSOR OPER. TEMP	SCALE FACTOR	MOTOR ST. I. RUN I. SYNC	1ST RUN	2ND RUN	3RD RUN	4TH RUN	5TH RUN	1ST RUN	2ND RUN	
118	A-B	42.86 42.98	754.0	753.7	0.63 0.70	10.81	1.95	1.95	161.2	465.0	170 157 62.79	T.S.F	41.2	41.2	41.2	41.2 41.2	0.001/HR	0.001/HR	
	B-C	43.29 43.41										MUSA	0.031	0.034	0.040	0.031 0.012	0.012	0.001/HR	
DATE	C-A	41.70 41.76										MUIA	0.034	0.032	0.030	0.022 0.062	0.062	0.001/HR	
1/25/78	P-M	42.38 42.70										RAVA	0.177	0.176	0.173	0.174 0.168	0.168	0.001/HR	
	W-U	42.55 42.60										RANDOM DRIFT							
	T-R	44.7 44.8										TWO	10	1AV	0.011	0.011	0.001/HR	0.001/HR	
	H-K	42.8 42.8										DAY	10	DAV	0.004	0.004	0.001/HR	0.001/HR	
	D-E	30.29 30.20										DAY	10	1AV	0.062	0.062	0.001/HR	0.001/HR	
	L-J	440.0 440.0										DAY	10	DAV	0.004	0.004	0.001/HR	0.001/HR	
118	A-B	42.67 42.08	754.6	756.6	0.51 0.64	10.51	1.915	1.947	161.7	470.0	166 150 62.40	T.S.F	41.1	41.1	41.1	41.1 41.1	0.001/HR	0.001/HR	
	B-C	43.09 43.44										MUSA	0.103	0.071	0.097	0.067 0.082	0.082	0.001/HR	
DATE	C-A	41.56 41.80										MUIA	0.007	0.000	0.006	0.011 0.023	0.023	0.001/HR	
4/25/78	P-M	44.21 44.33										RAVA	0.169	0.171	0.167	0.163 0.153	0.153	0.001/HR	
	W-U	43.8 43.7										RANDOM DRIFT							
	T-R	43.7 44.0										TWO	10	1AV	0.004	0.004	0.001/HR	0.001/HR	
	H-K	43.6 44.7										DAY	10	DAV	0.002	0.002	0.001/HR	0.001/HR	
	D-E	30.19 30.21										DAY	10	1AV	0.014	0.014	0.001/HR	0.001/HR	
	L-J	639.6 639.1										DAY	10	DAV	0.004	0.004	0.001/HR	0.001/HR	
121	A-B	41.10 41.36	637.7	643.5	0.36 0.57	10.60	1.54	1.80	163.2	455.0	182 174 60.99	T.S.F	0.016	0.014	0.011	0.009 0.011	0.011	0.001/HR	
	B-C	42.11 42.24	(Room Temp)									MUSA	0.056	0.057	0.076	0.052 0.106	0.106	0.001/HR	
	C-A	42.38 44.14										MUIA	0.414	0.417	0.457	0.441 0.451	0.451	0.001/HR	
	P-M	43.8 44.60										RAVA	0.034	0.039	0.073	0.073 0.071	0.071	0.001/HR	
	W-U	44.0 463.0										RANDOM DRIFT							
	T-R	44.4 44.3										TWO	10	1AV	0.013	0.013	0.001/HR	0.001/HR	
	H-K	44.7 44.2										DAY	10	DAV	0.009	0.009	0.001/HR	0.001/HR	
	D-E	31.0 30.76										DAY	10	1AV	0.026	0.026	0.001/HR	0.001/HR	
	L-J	637.3 637.3										DAY	10	DAV	0.003	0.003	0.001/HR	0.001/HR	

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10/CYBER SCALE PROPER 11-11-77										TORQUE SCALE FACTOR & DRIFT RATES										
NWC 702519018-4		OHMS	OHMS	OHMS	OHMS	MV MV	GYRO	DEF.	DEF.	OHMS	MV/DEF	MA	MA	SEC.						
S/N	PINS	PRE-TEST	SHIP	CONTROL	MONITOR	WIND	GAIN	ANGULAR	FREEDOM	TORQUE	SCALE	MOT	TO	R	1ST	2ND	3RD	4TH	5TH	
				OPERA. TEST	OPERA. TEST	FUND. TOTAL		IN. PHASE	OUT. OF PHASE	RES. OP. TEST					RUN	RUN	RUN	RUN	RUN	
108	A-B	39.30	39.24	758.0	752.3	0.57 0.72	11.19	1.79	1.93	163.2	447.5	203	198	57.65	T.S.F.	39.4	39.3	39.4	39.4	39.4
SN 124	B-C	39.99	39.69												MUSA	0.057	0.058	0.059	0.060	0.061
	C-A	39.92	39.60												MUIA	0.076	0.071	0.072	0.077	0.081
	P-M	14.57	14.55												ROAV	0.220	0.217	0.222	0.218	0.221
	W-U	256.9	250.7												RANDOM DRIFT					
	T-R	141.3	140.1												10	1AV	0.001	0.001	0.001	0.001
	H-K	642.0	635.1												10	OAV	0.002	0.002	0.002	0.002
	D-E	29.55	29.55												DAY	10	1AV	0.002	0.002	0.002
L-J	640.3	633.5												DAY	10	OAV	0.003	0.003	0.003	
105	A-B	40.98	40.99	754.9	757.0	0.58 0.58	10.99	1.55	2.12	162.5	447.5	197	189	56.33	T.S.F.	0.049	0.049	0.049	0.049	0.049
	B-C	41.98	41.49												MUSA	0.154	0.167	0.166	0.157	0.162
	C-A	41.27	40.81												MUIA	0.152	0.141	0.141	0.140	0.137
	P-M	14.56	14.47												ROAV	0.469	0.440	0.442	0.417	0.434
	W-U	235.5	252.7												RANDOM DRIFT					
	T-R	141.6	140.0												10	1AV	0.003	0.003	0.003	0.003
	H-K	642.4	634.7												10	OAV	0.002	0.002	0.002	0.002
	D-E	30.58	30.57												DAY	10	1AV	0.004	0.004	0.004
	L-J	640.4	632.0												DAY	10	OAV	0.004	0.004	0.004
006	A-B	41.25	41.39	736.1	743.1	0.48 0.70	11.01	1.76	2.24	166.7	445.0	199	193	51.75	T.S.F.	39.1	39.1	39.1	39.1	39.1
	B-C	41.75	41.89												MUSA	0.183	0.194	0.206	0.226	0.189
	C-A	41.15	41.32												MUIA	0.145	0.144	0.125	0.114	0.091
	P-M	14.49	14.63												ROAV	0.337	0.356	0.327	0.346	0.327
	W-U	268.0	269.4												RANDOM DRIFT					
	T-R	143.8	144.3												10	1AV	0.004	0.004	0.004	0.004
	H-K	624.3	626.7												DAY	10	OAV	0.006	"	"
	D-E	30.48	30.50												DAY	05	1AV	0.018	"	"
	L-J	619.0	621.8												DAY	10	OAV	0.009	"	"

RCP S/N	GYRO S/N	LOCATION ASSIGNMENT	HOURS BEFORE SKYLAB LAUNCH	REOWRK DIFFERENT GYRO GYRO S/N	HOURS AFTER REWORK	LIFE TEST HOURS	SKYLAB ORBIT HRS.	ORBIT HOURS IN 1978***	TOTAL
001	001	Qual Unit				20,000			20,000
002	008	Qual Unit				20,000			20,000
101	021	Sim Lab				4,906			4,906
102	002	Sim Lab				5,588			5,588
103	004	Sim Lab				9,712			9,712
104	009	Sim Lab				2,261			2,261
105	007	Sim Lab				2,251			2,251
106	022	Z3	632*				6,504	4,658	11,794
107	023	25KW	140.5	108	300				440.5
108	025	Pitch Primary**	632*				2		634
109	026	25KW	509	014	78				587
110	027	25KW	727.5	017	180				907.5
111	028	Yaw Primary	632*				3,960		4,592
112	024	Y5	632*				3,960	4,658	9,250
113	019	Y6	632*				3,960	4,658	9,250
114	005	25KW	808	027	271				1,079
115	012	X5	632*				3,960	4,658	9,250
116	017	25KW	841.5	105	93				934.5
117	020	X6	632*				3,960	4,658	9,250
118	016	25KW	644	016	138				782
119	015	Z6	632*				3,960	4,658	9,250
120	014	25KW	603	011	63				666
121	101	25KW	478	101	76				554

RGP S/N	GYRO S/N	LOCATION ASSIGNMENT	HOURS BEFORE SKYLAB LAUNCH	REWORK DIFFERENT GYRO GYRO S/N	HOURS AFTER REWORK	LIFE TEST HOURS	SKYLAB ORBIT HRS.	ORBIT HOURS IN 1978***	TOTAL
122	102	Z1**	632*				2		634
123	103	X2**	632*				2		634
124	108	25KW	1,263	005	103				1,366
125	106	Y2**	632*				2		634
126	107	Y3**	632*				2		634
127	118	25KW	313.5	118	50				363.5
128	109	Z2**	632*				2		634
129	119	Not Reworked	632*						632
130	111	Pitch Secondary	632*				5,000		5,632
131	117	Z5	632*				3,960	4,658	9,250
132	113	X1	632*				6,504	4,658	11,794
133	114	Yaw Secondary	632*				0		632
134	115	Y1	632*				6,504	4,658	11,794
135	116	X3	632*				4,500		5,132
	006	Spare				482.5			482.5
	023	Spare				495.6			495.6
	104	Spare				566.1			566.1
	121	Spare				492.5			492.5
									185,740.7

* These values (632) are an average of the 10 RGP's before rework at end of Skylab. Assumption is made that all boxes in orbit saw average time before Skylab launch.

** Hot units in orbit

*** These hours are through Dec. 26, 1978